CLAIMS

I claim:

1. A method for positioning a rudder of a ship wherein the rudder is driven by a rudder drive system in accordance with a rudder error determined by the difference between a selected rudder position provided by a rudder order from an autopilot or helm and a rudder position provided by a rudder repeatback signal, the rudder drive system having a rudder drive system turn off at a set rudder position, comprising the steps of:

determining rudder stop position after said rudder drive system is turned off;

comparing said stop position to said selected rudder position to establish a rudder stop error; and

resetting said set rudder position when said rudder stop error exceeds a predetermined position tolerance.

2. A method for positioning a rudder of a ship in accordance with claim 1 wherein said resetting step includes the steps of:

decreasing said set rudder position when said rudder stop error indicates that said rudder has stopped short of said rudder order; and

increasing said set rudder position when said rudder stop error indicates that said rudder has stopped a position that exceeds said rudder order.

3. A method for positioning a rudder of a ship in accordance with claim 2 wherein said decreasing step includes the steps of:

subtracting said rudder stop error from said set rudder position to provide an adjusted rudder drive system turn off; and

resetting said set rudder position to said adjusted rudder drive system turn off.

4. A method for positioning a rudder of a ship in accordance with claim 2 wherein said increasing step includes the steps of:

adding said rudder stop error to said set rudder position to provide an adjusted rudder drive system turn off; and

resetting said set rudder position to said adjusted rudder drive system turn off.

5. A method in accordance with claim 1 wherein said rudder drive system includes a solenoid energized at a second set rudder position, said solenoid coupled to an hydraulic pump which is activated when said solenoid is energized, further including the steps of;

establishing an energizing frequency for solenoid burn out protection thereby providing a burn out protection frequency;

determining when said energizing frequency exceeds said burn out protection frequency; and

adjusting said second set rudder position when said energizing frequency exceeds said burn out protection frequency.

6. A method in accordance with claim 5 wherein said second set rudder position is increased in said adjusting step.

7. A method in accordance with claim 5 wherein solenoid energizes are monitored to determine said energizing frequency in said determining step.

8. A method in accordance with claim 5 wherein hydraulic pump activations are monitored to determine said energizing frequency in said determining step.

9. A method in accordance with claim 1 further including the steps of:

monitoring rate of change of said repeatback signal;

determining if said rate of change is within acceptable limits; and

providing a warning when said rate of change is not within said acceptable limits.

10. A method for positioning a rudder of a ship wherein the rudder is driven by a rudder drive system in accordance with a rudder error determined by the difference between a selected rudder position provided by a rudder order from an autopilot or helm and a rudder position provided by a rudder repeatback signal, the rudder drive system, including a solenoid energized at a set rudder position, said solenoid coupled to an hydraulic pump which is activated when said solenoid is energized, comprising the steps of:

establishing an energizing frequency for solenoid burn out protection thereby providing a burn out protection frequency;

determining when said energizing frequency exceeds said burn out protection frequency; and

adjusting said second set rudder position when said energizing frequency exceeds said burn out protection frequency.

11. A method in accordance with claim 10 wherein said second set rudder position is increased in said adjusting step.

12. A method in accordance with claim 10 wherein solenoid energizes are monitored to determine said energizing frequency in said determining step.

13. A method in accordance with claim 10 wherein hydraulic pump activations are monitored to determine said energizing frequency in said determining step.

14. A rudder positioning apparatus of the type having a rudder drive system of the type driven in accordance with a rudder error determined by the difference between a selected rudder position provided by a rudder order from an autopilot or helm and a rudder position provided by a rudder repeatback signal, the rudder drive system having a turn off at a set rudder position comprising :

an undershoot/overshoot detector coupled to receive said rudder repeatback signal and said rudder order to determine rudder error at rudder stop position, thereby providing a rudder stop position error; and

a rudder position turn off adjuster coupled to receive said rudder stop position error and to said rudder drive system for resetting said turn off in accordance with said rudder stop position error.

15. A rudder positioning apparatus in accordance with claim 14 wherein said rudder position turnoff adjuster resets said turn off by decreasing said turn off when said rudder stop position error indicates that an undershoot of said rudder order has occurred and increasing said turnoff when said rudder stop position error indicates that an overshoot of said rudder order has occurred.

16 A rudder positioning apparatus in accordance with claim 14 wherein said turn off is reset by decreasing said turn off in accordance a difference between said set rudder stop position and said rudder stop position error when an undershoot occurs and increasing said turn off in accordance with a sum of said set rudder stop position and said rudder stop position error when an overshoot occurs.

17. A rudder positioning apparatus in accordance with claim 14 wherein said rudder drive system includes an hydraulic system having a solenoid energized at a second set rudder position, said solenoid coupled to a pump which is activated when said solenoid is energized, further including:

a frequency detector coupled to said hydraulic system to determine frequency of turn on of said hydraulic system, and

a solenoid turn on adjuster coupled to said solenoid of said hydraulic system and said frequency detector for increasing said second set rudder position when said frequency detector indicates that a predetermined frequency of solenoid energizes has been exceeded.

18. A rudder positioning apparatus in accordance with claim 17 wherein said frequency detector is coupled to said solenoid in said hydraulic system.

19. A rudder positioning apparatus in accordance with claim 17 wherein said frequency detector is coupled to said pump in said hydraulic system.

20. A rudder positioning apparatus in accordance with claim 14 further including a repeatback signal rate of change detector for monitoring operation of said rudder drive system.